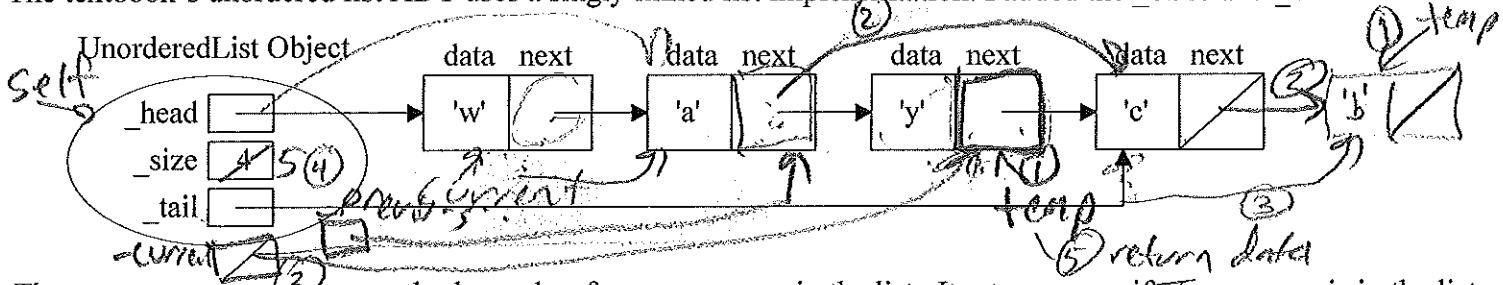
Data Structures (CS 1520) [07] Lecture 8 [07] Name: _____

1. The textbook's unordered list ADT uses a singly-linked list implementation. I added the `_size` and `_tail` attributes:



a) The `search(targetItem)` method searches for `targetItem` in the list. It returns `True` if `targetItem` is in the list; otherwise it returns `False`. Complete the `search(targetItem)` method code:

```
class UnorderedList:

    def search(self, targetItem):
        if self._current != None and self._current.getData() == targetItem:
            return True
        self._currentIndex = 0
        self._previous = None
        self._current = self._head
        while self._current != None:
            if self._current.getData() == targetItem:
                return True
                self._previous = self._current
            else:
                self._current = self._current.getNext()
                self._currentIndex += 1
        return False
```

b) The textbook's unordered list ADT **does not** allow duplicate items, so operations `add(item)`, `append(item)`, and `insert(pos, item)` would have what precondition?

Precondi: item value is not already in List

c) Complete the `append(item)` method including a check of it's precondition(s)?

```
    def append(self, item):
        if self.search(item):
            raise ValueError("Cannot append duplicate items to a List")
```

d) Why do you suppose I added a `_tail` attribute? To speedup operations like append. O(n) to O(1) with _tail

e) The textbook's `remove(item)` and `index(item)` operations "Assume the item is present in the list." Thus, they would have a precondition like "Item is in the list." When writing a program using an UnorderedList object (say `myGroceryList = UnorderedList()`), how would the programmer check if the precondition is satisfied?

```
itemToRemove = input("Enter the item to remove from the Grocery list: ")
if myGroceryList.search(itemToRemove):
   myGroceryList.remove(itemToRemove)
```

f) The `remove(item)` and `index(item)` methods both need to look for the `item`. What is inefficient in this whole process? Since they have the precondition check, they start by searching for the item again. We can tailor search method to set addition data attributes (self._current, self._previous, self._currentIndex) to speed these methods

g) Modify the `search(targetItem)` method code in (a) to set additional data attributes to aid the implementation of the `remove(item)` and `index(item)` methods.

h) Write the `index(item)` method including a check of its precondition(s).

```
def index(self, item):
    if not self.search(item):
        raise ValueError("~~~~")
    return self._currentIndex
```

i) Write the `remove(item)` method including a check of its precondition(s).

```
def remove(self, item):
    if not self.search(item):
        raise ValueError("~~~~")
    temp = self._current
    if self._previous == None: # deleting 1st node
        self._head = self._head.getNext()
    else:
        self._previous.setNext(self._current.getNext())
    if self._tail == self._current:
        self._tail = self._previous
    self._size -= 1
    self._current = None
    return temp.getData()
```

```
""" File:  unordered_linked_list.py
    Description:  Unordered List ADT implemented using singly-linked list.
"""

from node import Node

class UnorderedList(object):

    def __init__(self):
        """ Constructs an empty unsorted list.
            Precondition:  none
            Postcondition:  Reference to empty unsorted list returned.
        """
        self._head = None
        self._tail = None
        self._size = 0
        self._current = None
        self._previous = None
        self._currentIndex = -1

    def search(self, targetItem):
        """ Searches for the targetItem in the list.
            Precondition: none.
            Postcondition:  Returns True and makes it the current item if
targetItem is in the list;
                            otherwise False is returned.
        """
        if self._current != None and self._current.getData() == targetItem:
            return True

        self._previous = None
        self._current = self._head
        self._currentIndex = 0
        while self._current != None:
            if self._current.getData() == targetItem:
                return True
            else: #inch-worm down list
                self._previous = self._current
                self._current = self._current.getNext()
                self._currentIndex += 1
        return False

    def add(self, newItem):
        """ Adds the newItem to the list.
            Precondition: newItem is not in the list.
            Postcondition:  newItem is added to the list.
        """
        if self.search(newItem):
            raise ValueError("Cannot not add since item is already in the
list!")
```

```
        temp = Node(newItem)
        if self._size == 0:
            self._tail = temp
        else:
            temp.setNext(self._head)
        self._head = temp
        self._size += 1

    def remove(self, item):
        """ Removes item from the list.
            Precondition:  item is in the list.
            Postcondition:  Item is removed from the list.
        """
        if not self.search(item):
            raise ValueError("Cannot remove item since it is not in the
list!")

        if self._current == self._tail:
            self._tail = self._previous

        if self._current == self._head:
            self._head = self._head.getNext()
        else:
            self._previous.setNext(self._current.getNext())
        self._current = None
        self._size -= 1

    def isEmpty(self):
        """ Checks to see if the list is empty.
            Precondition:  none.
            Postcondition:  Returns True if the list is empty; otherwise
returns False.
        """
        return self._size == 0

    def length(self):
        """ Returns the number of items in the list.
            Precondition:  none.
            Postcondition:  Returns the number of items in the list.
        """
        return self._size

    def append(self, newItem):
        """ Adds the newItem to the tail of list.
            Precondition: newItem is not in the list.
            Postcondition:  newItem is added to the tail of list.
        """
        if self.search(newItem):
            raise ValueError("Cannot not append since item is already in the
list!")
```

```
        temp = Node(newItem)
        if self._size == 0:
            self._head = temp
        else:
            self._tail.setNext(temp)
        self._tail = temp
        self._size += 1

    def index(self, item):
        """ Returns the position of item in the list.
            Precondition:  item is in the list.
            Postcondition:  Returns the position of item from the head of
list.
        """
        if not self.search(item):
            raise ValueError("Cannot determine index since item is not in the
list!")

        return self._currentIndex

    def insert(self, pos, newItem):
        """ Inserts newItem at position pos of the list.
            Precondition:  position pos exists in the list, and newItem is
not in the list
            Postcondition:  The item has newItem inserted at position pos of
the list.
        """
        if not isinstance(pos, int):
            raise TypeError("Position must be an integer!")

        if pos < 0 or pos >= self._size:
            raise IndexError("Cannot insert because index", pos, "is
invalid!")

        if self.search(newItem):
            raise ValueError("Cannot insert because item is already in the
list!")

        temp = Node(newItem)

        self._current = self._head
        self._previous = None
        for count in range(pos):
            self._previous = self._current
            self._current = self._current.getNext()

        temp.setNext(self._current)
        if self._current == self._head:
            self._head = temp
        else:
            self._previous.setNext(temp)
```

```
        self._current = None
        self._size += 1


    def pop(self, pos = None):
        """ Removes and returns the item at position pos of the list.
            Precondition:  position pos exists in the list.
            Postcondition:  Removes and returns the item at position pos of
the list.
        """
        if pos == None:
            pos = self._size - 1

        if not isinstance(pos, int):
            raise TypeError("Position must be an integer!")

        if pos >= self._size or pos < 0:
            raise IndexError("Cannot pop from index", pos, "-- invalid
index!")

        self._current = self._head
        self._previous = None
        for count in range(pos):
            self._previous = self._current
            self._current = self._current.getNext()

        if self._current == self._tail:
            self._tail = self._previous

        if self._current == self._head:
            self._head = self._head.getNext()
        else:
            self._previous.setNext(self._current.getNext())
        returnValue = self._current.getData()
        self._current = None
        self._size -= 1
        return returnValue

    def __str__(self):
        """ Removes and returns the item at position pos of the list.
            Precondition:  position pos exists in the list.
            Postcondition:  Removes and returns the item at position pos of
the list.
        """
        resultStr = "(head)"
        current = self._head
        while current != None:
            resultStr += " " + str(current.getData())
            current = current.getNext()
        return resultStr + " (tail)"
```